FORM PTO-1390 (Modified) (REV 11-2000) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR
02-200	10/088433

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/ZA00/00172	15 September 2000 (15.09.00)	15 September 1999 (15.09.99)

TITLE OF INVENTION
LOW NOISE AMPLIFIER ARRANGEMENT

APPLICANT(S) FOR DO/EO/US
VISSER, Barend
DE JAGER, Ocker Cornelis

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include itens (5), (6), (9) and (24) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☐ is attached hereto (required only if not communicated by the International Bureau).
   b. ☒ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☐ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☐ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☐ Certificate of Mailing by Express Mail
23. ☒ Other items or information:

Return Receipt Postcard

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
10/088433	PCT/ZA00/00172	02-200

24. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

		CALCULATIONS PTO USE ONLY
☐	Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO	$1000.00
☒	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO	890 ~~$860.00~~
☐	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO	$710.00
☐	International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)	$690.00
☐	International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)	$100.00

ENTER APPROPRIATE BASIC FEE AMOUNT =	**$890.00**	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☒ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).	**$130.00**	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	33 - 20 =	13	x $18.00	**$234.00**	
Independent claims	4 - 3 =	1	x $84.00	**$84.00**	
Multiple Dependent Claims **(check if applicable)**.			☒	**$280.00**	
TOTAL OF ABOVE CALCULATIONS =				**$1,618.00**	
☒ Applicant claims small entity status. (See 37 CFR 1.27). The fees indicated above are reduced by 1/2.				**$809.00**	
SUBTOTAL =				**$809.00**	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)).			+	**$0.00**	
TOTAL NATIONAL FEE =				**$809.00**	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).** ☐				**$0.00**	
TOTAL FEES ENCLOSED =				**$809.00**	
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a. ☒ A check in the amount of **$809.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **13-2490** A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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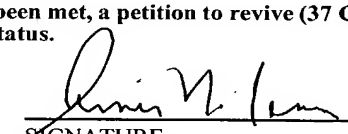
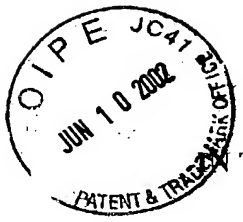


SIGNATURE

Amir N. Penn
NAME

40,767
REGISTRATION NUMBER

15 March 2002
DATE



(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
(Case No. 02-200)

In re Application of:	
Visser et al.	**Group Art Unit: Unassigned**
Serial No.: 10/088,433	**Examiner: Unassigned**
Filed: March 15, 2002	
For: Low Noise Amplifier Arrangement	

Commissioner of Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Dear Sir:

Applicants submit the following preliminary amendment.

IN THE CLAIMS:

Please cancel claims 5, 13 and 14 without prejudice. Please amend claims 1-4, 6, 10-12 as follows. Please add new claim 15. A marked up version of the amended claims, to show all the changes, is attached hereto on pages separate from the amendment in accordance with 37 CFR 1.121(c)(1)(ii).

1. (Amended) An amplifier arrangement for amplifying a signal having a full width half maximum (FWHM) parameter, the amplifier arrangement comprising:

- an input node provided on a first transmission medium;
- an output node provided on a second transmission medium;
- a plurality of amplifiers connected in respective spaced parallel paths extending between the first medium and the second medium;
- the input node dividing an input signal into signal parts and feeding the signal parts along respective paths to the output node;
- the paths having equal propagation delays for the signal parts, to provide at the output node an output signal comprising a summation of the signal parts; and
- the amplifier arrangement being characterized in that a spacing between one of said paths and an adjacent path being at least equal to a distance through which the signal would travel in a time corresponding to its FWHM parameter.

2. (Amended) An amplifier arrangement as claimed in claim 1 wherein the first transmission medium has one end and an opposite end, wherein the second transmission medium has one end and an opposite end and wherein the input node is provided towards the one end of the first transmission medium and the output node is provided towards the opposite end of the second transmission medium.

3. (Amended) An amplifier arrangement as claimed in claim 2 wherein the spacing between adjacent paths is constant.

4. (Amended) An amplifier arrangement as claimed in claim 3 wherein termination means is provided at the opposite end of the first transmission medium and at the one end of the second transmission medium.

6. (Amended) An amplifier arrangement as claimed in claim 4 wherein one of the first transmission medium and the second transmission medium comprises a transmission line.

10. (Amended) An amplifier arrangement as claimed in claim 6 wherein the second transmission medium comprises a three-dimensional cavity comprising signal absorbent means.

11. (Amended) A method of amplifying a signal having a full width half maximum (FWHM) parameter comprising the steps of:

- at an input node, dividing the signal into signal parts propagating along respective spaced paths to an output node;
- amplifying the signal parts in the paths by amplifying means in the paths;
- causing a propagating delay in each of the paths to be the same; and
- characterized by causing a spacing between adjacent paths to be at least equal to a distance through which the signal would travel in a time corresponding to the FWHM parameter of the signal, thereby at the output node, coherently summing the amplified signal parts, to provide an output signal; and incoherently summing noise added by the amplifying means.

12. (Amended) A method as claimed in claim 11 wherein the output signal is caused to propagate in predominantly a first direction towards an output, wherein noise is caused to propagate in another direction as well, and wherein the noise propagating in the other direction is absorbed by termination means.

15. (New claim) A noise suppressing amplifier arrangement comprising:

an input node provided on a first transmission medium:

an output node provided on a second transmission medium; and

a plurality of amplifiers connected in respective spaced parallel paths extending between the first medium and the second medium,

wherein the input node divides an input signal into signal parts and feeds the signal parts along respective paths to the output node;

wherein the paths having equal propagation delays for the signal parts; and wherein the second transmission medium comprises one of a two dimensional conductive layer and a three dimensional cavity arranged to allow signals to propagate in more than

one transverse direction in the second medium and coherently to sum the signal parts while suppressing noise generated by the amplifiers.

REMARKS

It is respectfully submitted that the presently pending claims in the application are believed to be in condition for allowance and patentably distinguish over the art of record. An early notice thereof is earnestly solicited.

Respectfully submitted,

Dated: 5/31/02

By: Amir N. Penn

Amir N. Penn
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APPENDIX UNDER 37 CFR 1.121(c)

1. (Amended) An amplifier arrangement for amplifying a signal having a full width half maximum (FWHM) parameter, the amplifier arrangement comprising:

- an input node provided on a first transmission medium;
- an output node provided on a second transmission medium;
- a plurality of amplifiers connected in respective spaced parallel paths extending between the first medium [input node] and the second medium [output node];
- the input node dividing an input signal into signal parts and feeding the signal parts along respective paths to the output node; [and]
- the paths having equal propagation delays for the signal parts, to provide at the output node an output signal comprising a summation of the signal parts; and
- the amplifier arrangement being characterized in that a spacing between one of said paths and an adjacent path being at least equal to a distance through which the signal would travel in a time corresponding to its FWHM parameter.

2. (Amended) An amplifier arrangement as claimed in claim 1 wherein the [comprising a] first transmission medium has [having] one end and an opposite end, wherein the [and a] second transmission medium has [having] one end and an opposite end and [,] wherein the input node is provided towards the one end of the first transmission medium and [, wherein] the output node is provided towards the opposite end of the second transmission medium [and wherein the parallel paths extend between the first transmission medium and the second transmission medium].

3. (Amended) An amplifier arrangement as claimed in claim 2 wherein the [a] spacing between adjacent paths is constant [one of said parallel paths and an adjacent parallel path on the first transmission medium is equal to a spacing between the one path and the adjacent path on the second transmission medium].

4. (Amended) An amplifier arrangement as claimed in [any one of claims 2 and] claim 3 wherein termination means is provided at the opposite end of the first transmission medium and at the one end of the second transmission medium.

6. (Amended) An amplifier arrangement as claimed in [any one of claims 2 to 5] claim 4 wherein one of the first transmission medium and the second transmission medium comprises a transmission line.

10. (Amended) An amplifier arrangement as claimed in [any one of claims 1 to] claim 6 wherein the second transmission medium comprises a three-dimensional cavity comprising signal absorbent means.

11. (Amended) A method of amplifying a signal having a full width half maximum (FWHM) parameter comprising the steps of:

- at an input node, dividing the signal into signal parts propagating along respective spaced paths to an output node;
- amplifying the signal parts in the paths by amplifying means in the paths;
- causing a propagating delay in each of the paths to be the same; and
- characterized by causing a spacing between adjacent paths to be at least equal to a distance through which the signal would travel in a time corresponding to the FWHM parameter of the signal, thereby at the output node, coherently summing the amplified signal parts, to provide an output signal; and incoherently summing noise added by the amplifying means.

12. (Amended) A method as claimed in claim 11 wherein the output signal is caused to propagate in predominantly a first direction towards an output, wherein noise is caused to propagate in another direction as well, and wherein the noise propagating in the other direction is absorbed by termination means.

15. (New claim) A noise suppressing amplifier arrangement comprising:
an input node provided on a first transmission medium:

an output node provided on a second transmission medium; and

a plurality of amplifiers connected in respective spaced parallel paths extending between the first medium and the second medium,

wherein the input node divides an input signal into signal parts and feeds the signal parts along respective paths to the output node;

wherein the paths having equal propagation delays for the signal parts; and wherein the second transmission medium comprises one of a two dimensional conductive layer and a three dimensional cavity arranged to allow signals to propagate in more than one transverse direction in the second medium and coherently to sum the signal parts while suppressing noise generated by the amplifiers.

LOW NOISE AMPLIFIER ARRANGEMENT

INTRODUCTION AND BACKGROUND

THE invention relates to amplifiers and more particularly to low noise amplifiers.

It is well known that in small signal applications, noise generated by or in, and contributed by an amplifier in a circuit for amplifying the small signal could overpower the signal.

OBJECT OF THE INVENTION

It is an object of the present invention to provide an amplifier arrangement and method of amplifying a signal with which the applicant believes the aforementioned problems may at least be alleviated.

SUMMARY OF THE INVENTION

According to the invention there is provided an amplifier arrangement comprising:

- an input node;
- an output node;
- a plurality of amplifiers connected in respective parallel paths extending between the input node and the output node;
- the input node dividing an input signal into signal parts and feeding the signal parts along respective paths to the output node; and

- the paths having equal propagation delays for the signal parts, to provide at the output node an output signal comprising a coherent summation of the signal parts.

The amplifier arrangement may comprise a first transmission medium having one end and an opposite end and a second transmission medium having one end and an opposite end, the input node may be provided towards the one end of the first transmission medium, the output node may be provided towards the opposite end of the second transmission medium and the parallel paths preferably extend between the first transmission medium and the second transmission medium.

A spacing between one of said parallel paths and an adjacent parallel path on the first transmission medium is preferably equal to a spacing between the one path and the adjacent path on the second transmission medium.

Termination means may be provided at the opposite end of the first transmission medium and at the one end of the second transmission means.

The amplifier arrangement may be adapted for amplifying a pulse having a pulse width and the spacing is preferably larger than a distance through which the pulse would travel through the medium in a time equal to the pulse width.

One of the first transmission medium and the second transmission medium may comprise a transmission line.

In some embodiments each of the first transmission medium and the second transmission medium comprises a coaxial cable.

In other embodiments each of the first transmission medium and the second transmission medium comprises a strip line.

In yet another embodiment the first transmission medium may comprise a transmission line and the second transmission medium may comprise a two dimensional conductive layer.

In still another embodiment the second transmission medium may comprise a three-dimensional cavity. The cavity may comprise signal absorbent means.

Also included within the scope of the present invention is a method of amplifying a signal comprising the steps of:

- at an input node, dividing the signal into signal parts propagating along respective paths to an output node;
- amplifying the signal parts in the paths by amplifying means in the paths;
- causing a propagating delay in each of the paths to be the same;
- at the output node, coherently summing the amplified signal parts to provide an output signal; and

- incoherently summing noise added by the amplifiers.

The output signal is preferably caused to propagate in predominantly a first direction towards an output, noise is preferably caused to propagate in another direction as well, and the noise propagating in the other direction is absorbed.

BRIEF DESCRIPTION OF THE ACCOMPANYING DIAGRAMS

The invention will now further be described, by way of example only, with reference to the accompanying diagrams wherein;

figure 1 is a diagrammatic representation of a first embodiment of the amplifier arrangement according to the invention;

figure 2 is a diagrammatic representation of a second embodiment of the arrangement;

figure 3 is a diagrammatic representation of a third embodiment of the arrangement wherein the outputs of amplifier stages are connected to a two-dimensional surface;

figure 4 is a diagrammatic representation of a further embodiment of the arrangement wherein the outputs of amplifier stages are fed into a three-dimensional cavity; and

figure 5 is a graph of signal response and noise response against spacing between adjacent amplifier stages in the arrangement.

DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

In figure 1, a first embodiment of the amplifier arrangement according to the invention is generally designated by the reference numeral 10.

The arrangement 10 is connected as a pre-amplifier arrangement to main amplifier 12. The arrangement includes first and second transmission media in the form of first and second co-axial cables 14 and 16. Cable 16 provides at one end 16.1 thereof an input 18. The other or opposite end 16.2 thereof is properly terminated by termination means in the form of a resistor 21. The cable 14 also comprises one end 14.1 and an opposite end 14.2. The opposite end 14.2 of cable 14 constitutes output 19 of the arrangement which output is connected to an input of the main amplifier 12. The one end 14.1 of cable 14 is properly terminated by termination means in the form of a resistor 22.

The arrangement further comprises an input node 24 and an output node 26. A plurality of parallel paths 28.1. to 28.4 are provided between the input node and the output node. The signal propagation delay through each of these paths is the same. In each of paths 28.1 to 28.4 there is connected a respective amplifier stage 20.1 to 20.4. The amplifier stages 20.1 to 20.4 may each include a transistor (not shown) connected in common emitter configuration and the main amplifier 12 may include a transistor (also not shown) connected in common base configuration.

An input signal $S_i(t)$ at the input 18 is divided along line 16 into signal parts $s_1(t)$ propagating along path 28.1 to output node 26, signal part $s_2(t)$ propagating along path 28.2 to output node 26, signal part $s_3(t)$ propagating along path 28.3 to output node 26 and signal part $s_4(t)$ propagating along path 28.4 to output node 26.

Because the propagating delays through the paths are the same the signal parts will at the same time arrive at node 26, where they are coherently summed to constitute an output signal $S_o(t)$. The energy in the output signal propagates predominantly from node 26 towards output 19. On the other hand, noise generated by the amplifiers 20.1 to 20.4 are incoherently added or summed along line 14. Furthermore, at least part of the noise propagates away from output 19 towards resistor 22 where it is absorbed. It is believed that the arrangement according to the invention provides improved noise suppression characteristics.

In figure 2, there is shown a strip line implementation of the arrangement marked 100. The input of the arrangement 100 is provided at 118 at the one end of first line 114. First strip line 114 is a 50 line terminated by a 50 resistor 121 at the other end thereof. A second strip line 116, which is a 10 line, extends parallel to the first line and is spaced about 5 mm from the first line. The second line 116 is connected at an output 119 to an output amplifier 112. The output amplifier 121 is connected in conventional way to a 50 output strip line 127. The line 116 is terminated at its one end by a resistor 122.

The amplifiers 120.1 to 120.4 comprise common source FET's and are interspaced by a distance (_) equal to 7.5 cm. The propagation speed of the signal through the strip lines is $^{c}/_{2}$, where c is equal to the speed of light. Hence, the spacing _ corresponds to a full width half maximum (FWHM) value of 0.5 ns for an input pulse $S_i(t)$.

In figure 5, there is shown a graph of the output signal $S_o(t)$ in the form of relative signal energy marked 50 and relative RMS signal voltage marked 52 against the ratio of full width half maximum (FWHM) of the input pulse and spacing ( ) between paths. With the ratio equal to one, that is with the aforementioned spacing of 7.5 cm and a pulse with FWHM = 0.5 ns, about 75% (see numeral 56 on the graph) of the summed signal propagates towards output 119. A graph of output noise is also shown at 54 and it is clear that less than 50% of noise generated propagates towards output 119.

It will also be seen from figure 5 that signal loses for short pulses, that is pulses substantially shorter than the spacing ( ) is lower than for larger pulses.

In figure 3, a further embodiment of the arrangement is shown designated 40. In this embodiment the outputs of the amplifier stages 20.1 to 20.4 are connected to a two-dimensional conductive surface 44. The output of the arrangement 40 is provided at 46 between opposed conductive surfaces 44

and 48. A coherent summation of signal parts of an input signal provided at 42 is available at output 46. Suitable termination elements (not shown) may be applied to the arrangement 40 to dissipate noise. It is believed that a two dimensional arrangement (as shown in figure 3) may have even better noise suppression characteristics than a one-dimensional arrangement (as shown in figure 1).

In figure 4, there is shown yet a further embodiment of the arrangement according to the invention designated 200. The arrangement 200 comprises a first transmission medium in the form of a coaxial cable 214 providing an input at 218. Amplifiers 220.1 to 220.4 are connected in parallel paths 222.1 to 222.4 and are connected to antennas 228.1 to 228.4 located in a three-dimensional cavity 230 defined by an enclosure 232. The enclosure 232 comprises a conductive floor 234 and the dome-shaped sidewalls are cladded with absorbent material. Output 219 is connected to output amplifier 212. It is believed that this configuration also provides improved noise suppression characteristics.

Thus, it is hence envisaged that arrangements having two-dimensional (surface technology) or three-dimensional (volume technology) input arrangements and/or two-dimensional or three-dimensional output arrangements also fall within the scope of the invention.

It will be appreciated that there are many variations in detail on the amplifier arrangement and method according to the invention without departing from the scope and spirit of the appended claims.

CLAIMS

1. An amplifier arrangement comprising:

   - an input node;
   - an output node;
   - a plurality of amplifiers connected in respective parallel paths extending between the input node and the output node;
   - the input node dividing an input signal into signal parts and feeding the signal parts along respective paths to the output node; and
   - the paths having equal propagation delays for the signal parts, to provide at the output node an output signal comprising a summation of the signal parts.

2. An amplifier arrangement as claimed in claim 1 comprising a first transmission medium having one end and an opposite end and a second transmission medium having one end and an opposite end, wherein the input node is provided towards the one end of the first transmission medium, wherein the output node is provided towards the opposite end of the second transmission medium and wherein the parallel paths extend between the first transmission medium and the second transmission medium.

3. An amplifier arrangement as claimed in claim 2 wherein a spacing between one of said parallel paths and an adjacent parallel path on the

first transmission medium is equal to a spacing between the one path and the adjacent path on the second transmission medium.

4. An amplifier arrangement as claimed in any one of claims 2 and 3 wherein termination means is provided at the opposite end of the first transmission medium and at the one end of the second transmission medium.

5. An amplifier arrangement as claimed in claim 3 or claim 4 for amplifying a pulse having a pulse width and wherein the spacing is larger than a distance through which the pulse would travel through the medium in a time equal to the pulse width.

6. An amplifier arrangement as claimed in any one of claims 2 to 5 wherein one of the first transmission medium and the second transmission medium comprises a transmission line.

7. An amplifier arrangement as claimed in claim 6 wherein each of the first transmission medium and the second transmission medium comprises a coaxial cable.

8. An amplifier arrangement as claimed in claim 6 wherein each of the first transmission medium and the second transmission medium comprises a strip line.

9. An amplifier arrangement as claimed in claim 6 wherein the first transmission medium comprises a transmission line and the second transmission medium comprises a two dimensional conductive layer.

10. An amplifier arrangement as claimed in any one of claims 1 to 6 wherein the second transmission medium comprises a three-dimensional cavity comprising signal absorbent means.

11. A method of amplifying a signal comprising the steps of:

- at an input node, dividing the signal into signal parts propagating along respective paths to an output node;
- amplifying the signal parts in the paths by amplifying means in the paths;
- causing a propagating delay in each of the paths to be the same;
- at the output node, coherently summing the amplified signal parts, to provide an output signal; and
- incoherently summing noise added by the amplifying means.

12. A method as claimed in claim 11 wherein the output signal is caused to propagate in predominantly a first direction towards an output, wherein noise is caused to propagate in another direction as well, and wherein the noise propagating in the other direction is absorbed.

13. An amplifier arrangement substantially as herein described with reference to the accompanying diagrams.

14. A method of amplifying a signal substantially as herein described with reference to the accompanying diagrams.

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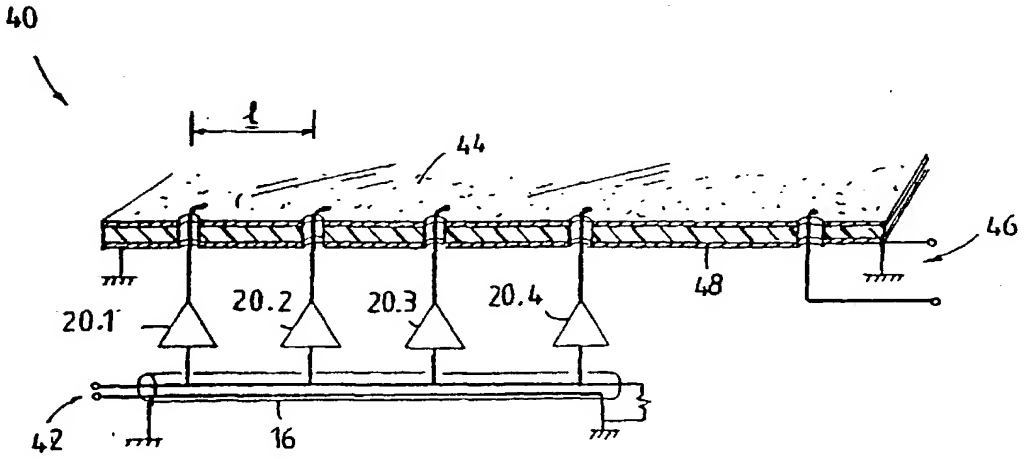
— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: LOW NOISE AMPLIFIER ARRANGEMENT



(57) Abstract: An amplifier arrangement (10) comprises an input node (24) and an output node (26). A plurality of amplifiers (20.1 to 20.4) are connected in respective parallel paths (28.1 to 28.4) extending between the input node and the output node. The input node divides an input signal $S_i(t)$ into signal parts $s_1(t)$ to $s_4(t)$ and feeds the signal parts along respective paths to the output node. The paths have equal propagation delays for the signal parts, to provide at the output node an output signal $S_o(t)$ comprising a coherent summation of the signal parts and an incoherent summation of noise.

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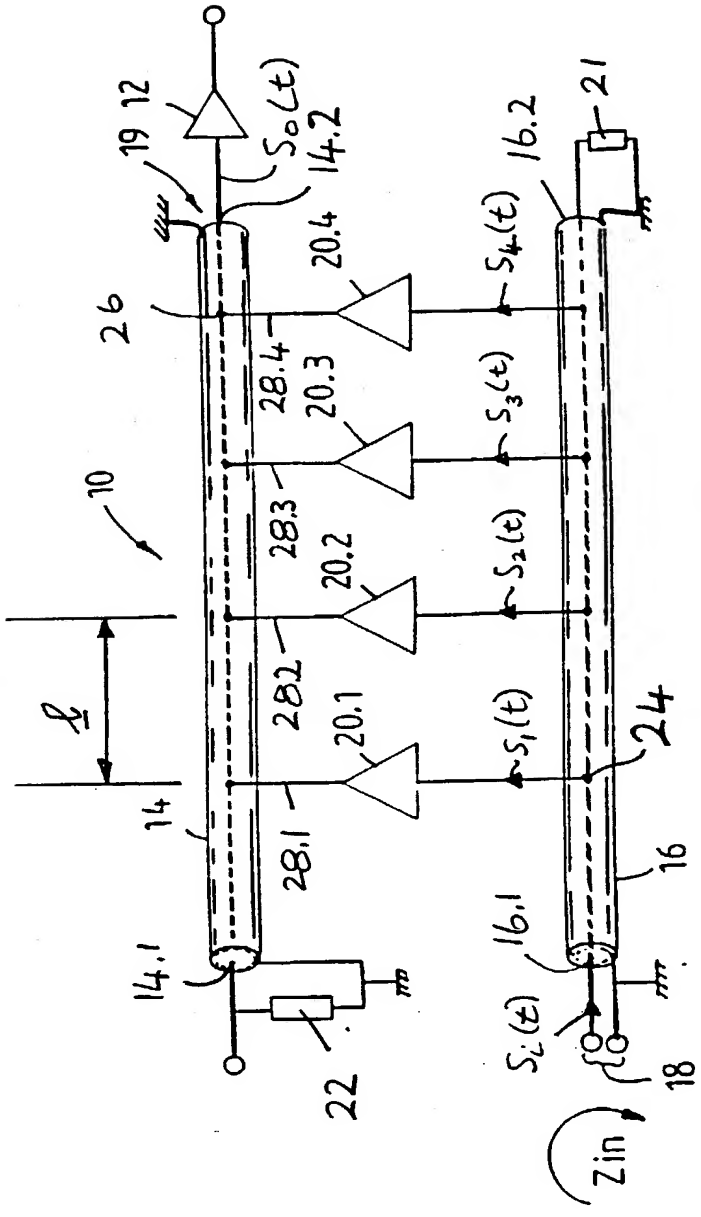
19
12
$S_0(t)$
14.2
21
16.2
$S_4(t)$
20.4
26
28.4
20.3
$S_3(t)$
10
28.3
20.2
$S_2(t)$
ℓ
28.2
20.1
$S_1(t)$
24
14
28.1
16
16.1
14.1
$S_i(t)$
18
22
Zin

FIGURE 1

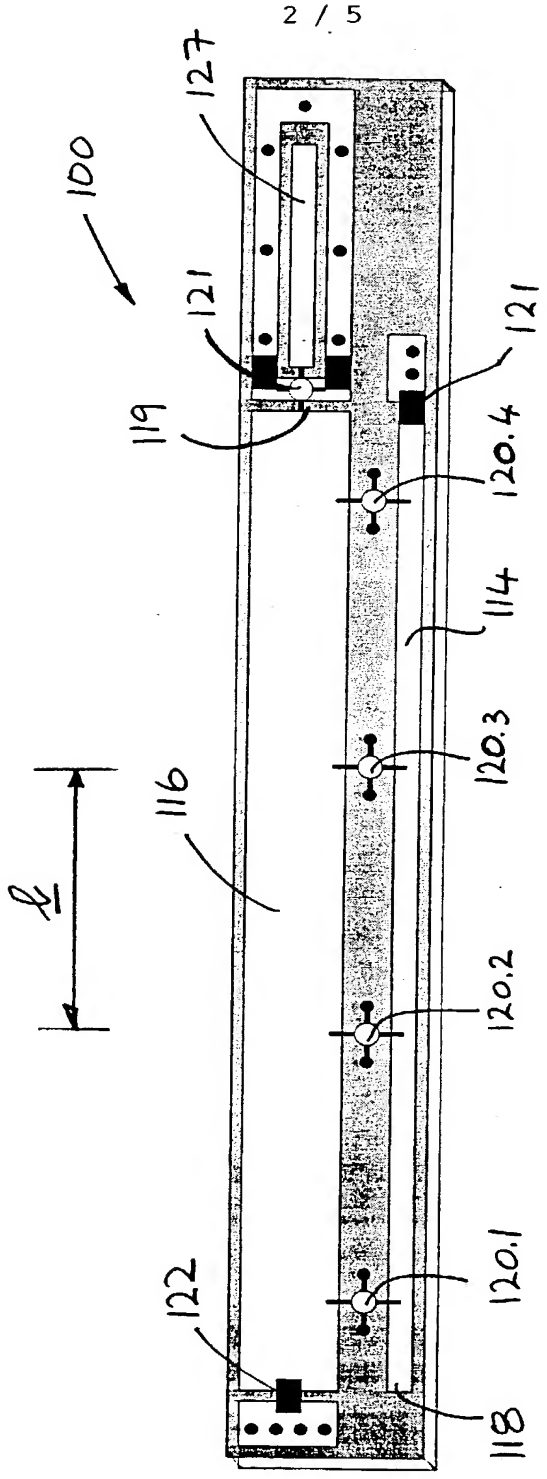

FIGURE 2

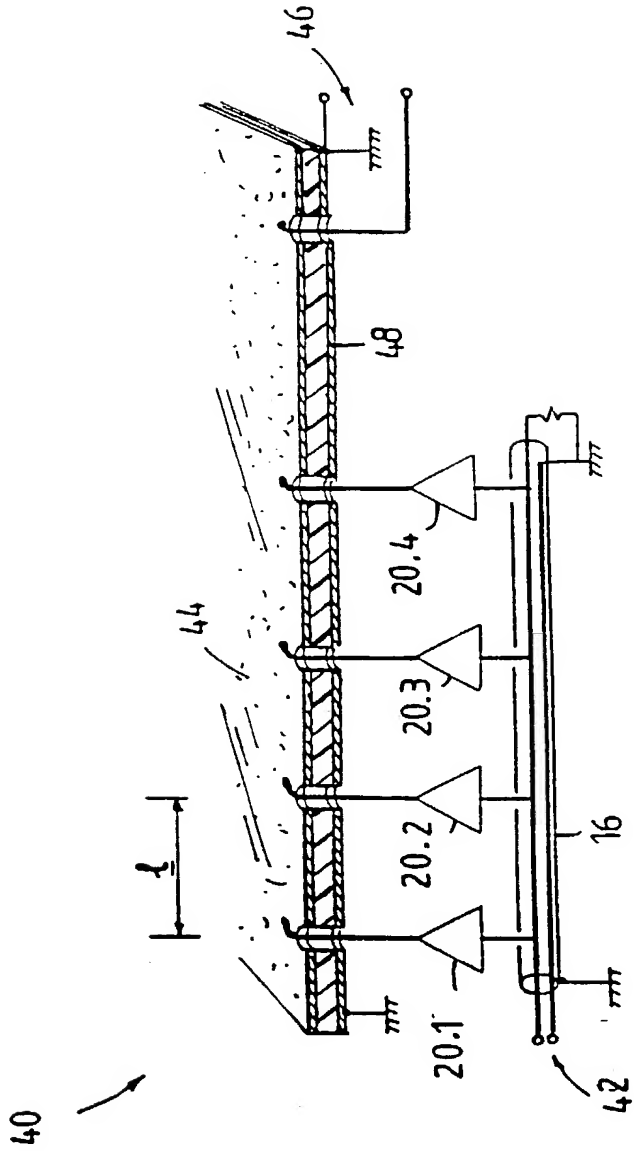

FIGURE 3

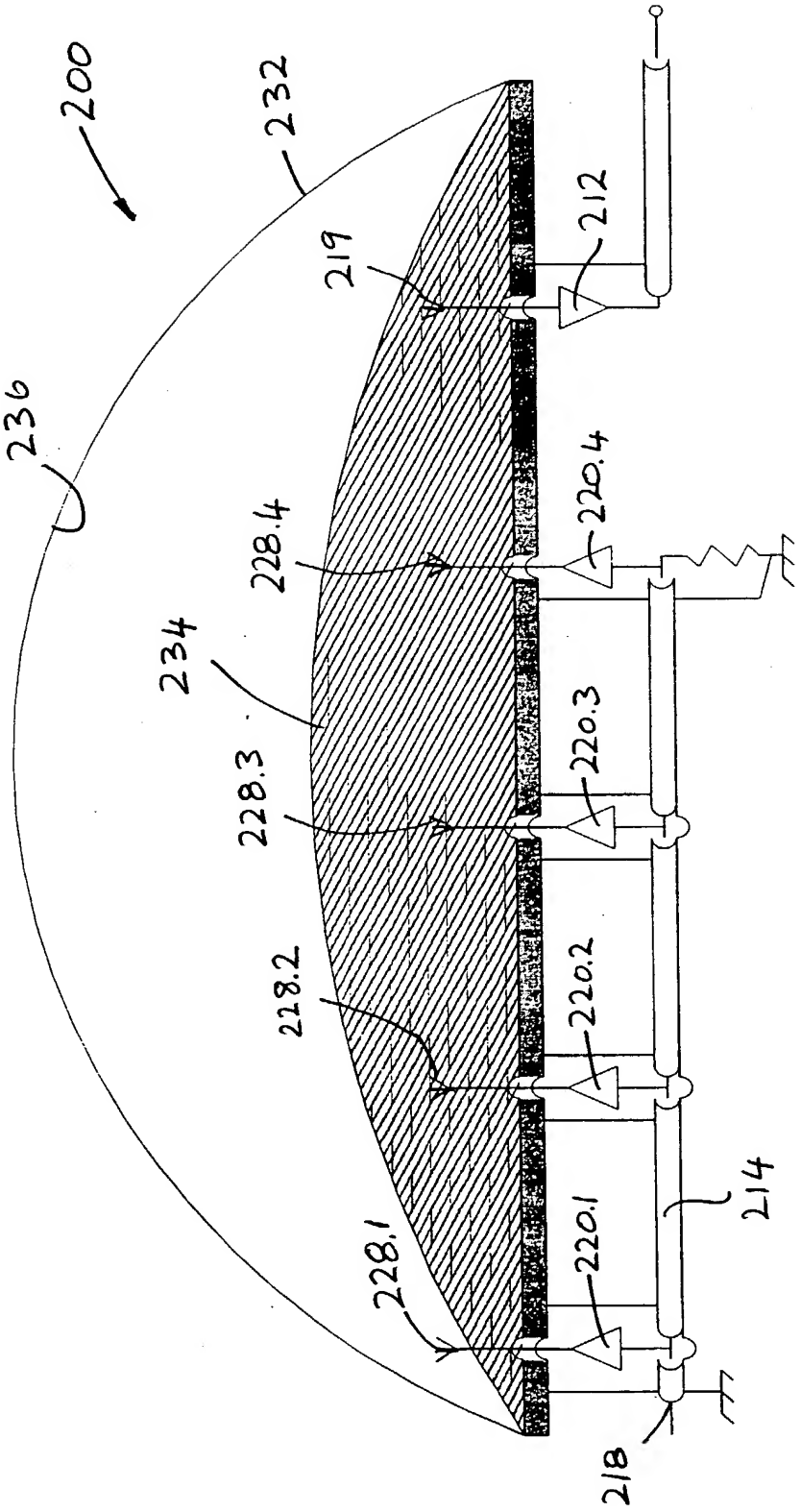

FIGURE 4.

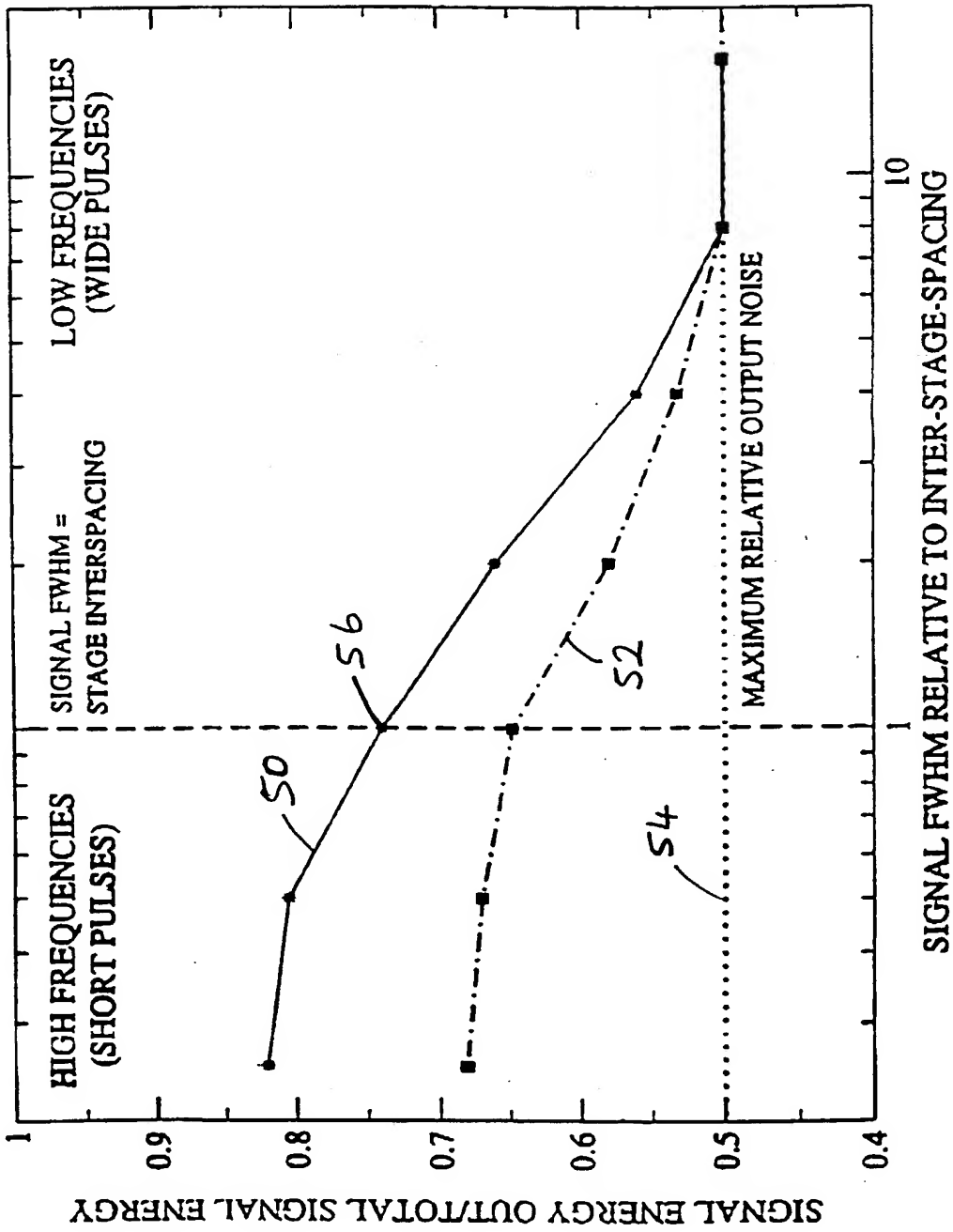
SIGNAL ENERGY OUT/TOTAL SIGNAL ENERGY
1
0.9
0.8
0.7
0.6
0.5
0.4
HIGH FREQUENCIES (SHORT PULSES)
LOW FREQUENCIES (WIDE PULSES)
SIGNAL FWHM = STAGE INTERSPACING
MAXIMUM RELATIVE OUTPUT NOISE
1
10
SIGNAL FWHM RELATIVE TO INTER-STAGE-SPACING
50
56
52
54

FIGURE 5.

Case No.: 02-200

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Low Noise Amplifier Arrangement

the specification of which is attached hereto unless the following space is checked:

☒ was filed on September 15, 2000 as United States Application Serial Number 10/088,433.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT international application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s):

	Number	Country	Day/Month/Year Filed
1.	99/5930	South Africa	15 September 1999
2.			

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below:

	Application Number	Filing Date
1.		
2.		

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s), or § 365(c) of any PCT international application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

	Application Number	Filing Date	Status: patented, pending, abandoned
1.	PCT/ZA00/00172	15 September 2000	pending
2.			

I hereby appoint the practitioners associated with the Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and I direct that all correspondence be addressed to that Customer Number.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

100

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200

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